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PHOTOELECTRIC REFLECTANCE METHOD FOR MEASUREMENT OF WHITENESS OF PLANTATION WHITE SUGAR IN SOLID STATE

(First Revision)

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PHOTOELECTRIC REFLECTANCE METHOD FOR MEASUREMENT OF WHITENESS OF PLANTATION WHITE SUGAR IN SOLID STATE

(First Revision)

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PHOTOELECTRIC REFLECTANCE METHOD FOR MEASUREMENT OF WHITENESS OF PLANTATION WHITE SUGAR IN SOLID STATE

(*First Revision*)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 28 January 1987, after the draft finalized by the Sugar Industry Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 Plantation white sugar is manufactured and commercially transacted on the basis of visual comparison of colour and grain size as prescribed in IS : 498-1986*. While the grain size is determined by employing various sieves, the whiteness of sugar in the reference samples prepared by the Bureau of Sugar Standards is determined by the photoelectric reflectance meter. The principal object of the development of this standard covering photoelectric reflectance method is to specify the procedure for preparing reference samples of identical whiteness eliminating personal errors. This is necessary to be done every year as whiteness is affected during storage. Besides, the standard method would also help in scientific evaluation of such issues as the introduction of new colour grades.

0.3 This standard was first published in 1974 to cover plantation white sugar manufactured and commercially transacted on the basis of visual comparison of colour and grain size as was prescribed in IS : 498-1970. IS : 498 has now been revised in the light of the decision of the Government of India to reduce the number of sugar grades to six only in two colour series namely L-30, M-30, S-30 and L-29, M-29, and S-29. These six grades have been included in the revised IS : 498-1986*. Therefore, it became imperative to revise IS : 7424 giving the modulated reflectance values of these six grades.

0.4 Reflectance values of sugar are obtained through the photoelectric reflectance meter, which are converted to modulated reflectance (MR)

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*Grading for vacuum pan sugar (plantation white) (*fourth revision*).

values, by multiplying them with grain size of sugar. The MR values thus obtained are utilized for gradation of plantation white sugar.

0.5 This standard is based on extensive research investigations carried out on the method of evaluation of whiteness of plantation sugar in solid state at the National Sugar Institute, Kanpur. The method had been published in the ISI *Bul* 18, 8; 1966 ; 359-64 and later elaborated in the proceedings of the fourth joint convention of the Sugar Technologists Association. The method has also been rechecked at the National Physical Laboratory, New Delhi.

0.5.1 With a view to facilitating preparation of reference samples of sugar or to arrive independently at the modulated reflectance values of different grades of plantation white sugar, the MR values are given in Appendix A.

0.6 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard prescribes the method of measurement of whiteness of plantation white sugar (vacuum pan) in solid state by means of photoelectric reflectance meter for preparation of reference samples and introduction of higher colour grades.

1.1.1 This method is not intended for day-to-day routine grading of sugar in sugar factories which shall be done on the basis of visual comparison with reference samples.

2. APPARATUS

2.1 Photoelectric Reflectometer — Furnished with two-way operation from both 230 V ac mains and 6-8 V storage battery. It shall be provided with a search unit and a display unit. The indicating meter in the display unit shall have a linear reflectance scale reading from 0 to 100 percent reflectance. Each division of the meter will represent a change of 1 percent in reflectance value. The meter shall be of at least 1 percent accuracy.

2.1.1 Coarse and fine controls shall be provided in the display unit for zero and sensitivity adjustments of the indicating meter. The display unit shall have an arrangement for reading the voltage across the search

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*Rules for rounding off numerical values (*revised*).

unit lamp with an accuracy of 0·15 V. A suitable variable resister shall be provided in the display unit to adjust the search unit lamp voltage.

2.1.2 The search unit shall be provided with a 6 V concentrated filament lamp. For mains operation, a constant voltage transformer or an equivalent device will be provided to keep the lamp voltage constant to within 5 percent of the required value. Light from the lamp should strike the sample at normal incidence after collimation through suitable condenser lenses. The diameter of the beam at the sample plane shall be about 10 mm. Suitable colour correcting filter or filters shall be placed in the parallel beam of light. The filters shall be used to correct the colour sensitivity of the photo-cell to match it with that of the eye and also to correct the colour temperature of the lamp to make it equal to that of illuminant. The operating voltage of the lamp shall be specified. At this voltage the lamp along with the correcting filter gives the required colour temperature. The two filters, namely, the colour temperature correction filter and the colour correction filter may be combined into one.

2.1.3 The photo-cell unit of the search unit shall consist of two selenium photo-cells. One of these, the compensating photo-cell, shall receive filtered light directly from the lamp. The other, that is, the measuring photo-cell, shall receive light reflected from the sample. The position of the measuring photo-cell shall be such that its central area receives light reflected at about 45° from the sample.

2.1.4 The colour correction filter shall give the luminous reflectance or Y value of trichromatic stimuli. One amber and one blue filter may be also provided with the search unit to measure the X and Z tristimulus values.

2.2 Reflectance Standard — It should be a freshly prepared magnesium oxide surface whose reflectance shall be taken to be 100 percent. However, for convenience, the following reflectance standards shall be provided with the instrument:

a) A white enamel plaque of reflectance not less than 80 percent with its reflectance value calibrated against magnesium oxide.

b) A grey enamel plaque of reflectance about 40 percent with its reflectance calibrated against magnesium oxide.

c) A highly polished black glass plate.

3. MEASUREMENT OF REFLECTANCE

3.1 Connect the instrument to ac power mains or to 6-8 V storage battery. Adjust the lamp voltage to the specified value and adjust the galvanometer to zero with the help of the knob meant for the purpose. Put the green filter (colour correcting filter) in the search unit and place it on the polished black glass plate. The meter shall then indicate zero reflectance, if not, adjust the zero controls to set the meter to zero. Then place the search unit on the standard white plaque and adjust the sensitivity controls to get the correct reflectance reading for this calibrated plaque. Now place the search unit on the grey enamel plaque and check that the meter gives correct value of reflectance for this calibrated plaque. This is a check of the linearity of the meter scale. The plaques and the black plates shall be washed with neutral detergents or soft soaps and dried before use. Care shall be taken not to scratch their surfaces, specially that of the black glass plate. After suitable intervals the reflectance values of the white and grey enamel plaques shall be checked against magnesium oxide standard.

4. CALCULATION

4.1 Take the mean reflectance value of the four surfaces of the sugar in the bottle. Obtain the modulated reflectance (MR) values by the following formula:

$$\text{Modulated reflectance (MR)} = R \times G$$

where

R = mean reflectance value of the four surfaces of the sugar in bottle and

G = grain size of the sugar in mm.

APPENDIX A

(*Clause* 0.5.1)

MINIMUM VALUES OF MODULATED REFLECTANCE OF PLANTATION WHITE SUGAR*

GRAIN SIZE DESIGNATION	GRAIN SIZE, IN mm *Max*	*Min*	STANDARD MR VALUES, *Min*
(1)	(2)	(3)	(4)
L-30	2·36	1·70	82
M-30	1·70	1·18	60
S-30	1·18	0·60	37
L-29	2·36	1·70	70
M-29	1·73	1·18	52
S-29	1·18	0·60	34

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*As recorded in the first week of August every year.

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